

THE INVENTION CLAIMED IS:

1 1. A scheduler for a network processor,
2 comprising:
3 one or more scheduling queues, each adapted to
4 define a respective sequence in which flows are to be
5 serviced; and
6 one or more empty indicators, each empty indicator
7 being associated with a respective scheduling queue to
8 indicate whether the respective scheduling queue is empty.

1 2. The scheduler of claim 1, wherein each empty
2 indicator is a bit in a register.

1 3. The scheduler of claim 1, wherein the one or
2 more scheduling queues include 64 scheduling queues and the
3 one or more empty indicators include 64 empty indicators.

1 4. The scheduler of claim 1, wherein each
2 scheduling queue includes 512 slots to which flows are
3 attachable.

1 5. A method of dequeuing a flow from a
2 scheduling queue, comprising:
3 examining an empty indicator associated with the
4 scheduling queue;
5 refraining from searching the scheduling queue if
6 the empty indicator indicates that the scheduling queue is
7 empty;
8 searching the scheduling queue if the empty
9 indicator indicates that the scheduling queue is not empty;
10 and

11 detaching from the scheduling queue a winning flow
12 found in the searching step.

1 6. The method of claim 5, further comprising,
2 prior to the examining step, selecting the scheduling queue
3 from among a plurality of scheduling queues in a round robin
4 process.

1 7. The method of claim 5, wherein the searching
2 step includes searching a plurality of subqueues included in
3 the scheduling queue, the subqueues having mutually
4 different respective ranges and resolutions.

1 8. The method of claim 5, wherein the examining
2 step includes checking a bit in a register.

1 9. A method of enqueueing a flow to a scheduling
2 queue, comprising:
3 attaching a flow to the scheduling queue; and
4 placing an empty indicator associated with the
5 scheduling queue in a condition to indicate that the
6 scheduling queue is not empty.

1 10. The method of claim 9, wherein the attaching
2 step includes assigning the flow to a slot in the scheduling
3 queue according to the formula $CP + ((WF \times FS)/SF)$, where:
4 CP is a pointer that indicates a current position
5 in the scheduling queue;
6 WF is a weighting factor associated with the flow;
7 FS is a size of a data frame associated with the
8 flow; and

9 SF is a scaling factor.

1 11. The method of claim 9, wherein the placing
2 step includes setting a bit in a register.

1 12. The method of claim 9, wherein the placing
2 step includes resetting a bit in a register.

1 13. A method of dequeuing a flow from a
2 scheduling queue, comprising:

3 examining an empty indicator associated with the
4 scheduling queue;

5 refraining from searching the scheduling queue if
6 the empty indicator indicates that the scheduling queue is
7 empty;

8 searching the scheduling queue if the empty
9 indicator indicates that the scheduling queue is not empty;

10 if a winning flow is found in the searching step,
11 detaching the winning flow from the scheduling queue; and

12 if no flow is found in the searching step, placing
13 the empty indicator in a condition to indicate that the
14 scheduling queue is empty.

1 14. The method of claim 13, further comprising,
2 prior to the examining step, selecting the scheduling queue
3 from among a plurality of scheduling queues in a round robin
4 process.

1 15. The method of claim 13, wherein the searching
2 step includes searching a plurality of subqueues included in

3 the scheduling queue, the subqueues having mutually
4 different respective ranges and resolutions.

1 16. The method of claim 13, wherein the examining
2 step includes checking a bit in a register.

1 17. The method of claim 13, wherein, if the
2 detaching step is performed, a further search of the
3 scheduling queue is performed to determine whether any flows
4 are enqueued in the scheduling queue other than the flow
5 detached in the detaching step.

1 18. The method of claim 17, wherein the empty
2 indicator is placed in a condition to indicate that the
3 scheduling queue is empty if the further search of the
4 scheduling queue determines that there are no flows in the
5 scheduling queue other than the flow detached in the
6 detaching step.

1 19. A scheduler for a network processor,
2 comprising:

3 one or more scheduling queues, each adapted
4 to define a respective sequence in which flows are to be
5 serviced; and

6 one or more empty indicators, each empty
7 indicator being associated with a respective scheduling
8 queue to indicate whether the respective scheduling queue is
9 empty;

10 wherein the scheduler is adapted to:

11 examine an empty indicator associated
12 with a first scheduling queue;

13 refrain from searching the first
14 scheduling queue if the empty indicator indicates that the
15 first scheduling queue is empty;
16 search the first scheduling queue if the
17 empty indicator indicates that the first scheduling queue is
18 not empty; and
19 detach from the first scheduling queue a
20 winning flow found in the search of the first scheduling
21 queue.

1 20. A scheduler for a network processor,
2 comprising:

3 one or more scheduling queues, each adapted
4 to define a respective sequence in which flows are to be
5 serviced; and

6 one or more empty indicators, each empty
7 indicator being associated with a respective scheduling
8 queue to indicate whether the respective scheduling queue is
9 empty;

10 wherein the scheduler is adapted to:

11 attach a flow to a first scheduling
12 queue; and

13 place an empty indicator associated with
14 the first scheduling queue in a condition to indicate that
15 the first scheduling queue is not empty.

1 21. A scheduler for a network processor,
2 comprising:

3 one or more scheduling queues, each adapted
4 to define a respective sequence in which flows are to be
5 serviced; and

6 one or more empty indicators, each empty
7 indicator being associated with a respective scheduling
8 queue to indicate whether the respective scheduling queue is
9 empty;

10 wherein the scheduler is adapted to:

11 examine an empty indicator associated
12 with a first scheduling queue;

13 refrain from searching the first
14 scheduling queue if the empty indicator indicates that the
15 first scheduling queue is empty;

16 search the first scheduling queue if the
17 empty indicator indicates that the first scheduling queue is
18 not empty;

19 if a winning flow is found by the search
20 of the first scheduling queue, detach the winning flow from
21 the first scheduling queue; and

22 if no flow is found by the search of the
23 first scheduling queue, place the empty indicator in a
24 condition to indicate that the first scheduling queue is
25 empty.

1 22. A computer program product adapted to dequeue
2 a flow from a scheduling queue, the computer program product
3 comprising:

4 a medium readable by a computer, the computer
5 readable medium having computer program code adapted to:

6 examine an empty indicator associated
7 with the scheduling queue;

8 refrain from searching the scheduling
9 queue if the empty indicator indicates that the scheduling
10 queue is empty;

11 search the scheduling queue if the empty
12 indicator indicates that the scheduling queue is not empty;
13 and
14 detach from the scheduling queue a
15 winning flow found in the search of the scheduling queue.

1 23. A computer program product adapted to enqueue
2 a flow to a scheduling queue, the computer program product
3 comprising:

4 a medium readable by a computer, the computer
5 readable medium having computer program code adapted to:

6 attach a flow to the scheduling queue;
7 and

8 place an empty indicator associated with
9 the scheduling queue in a condition to indicate that the
10 scheduling queue is not empty.

11 24. A computer program product adapted to dequeue
12 a flow from a scheduling queue, the computer program product
comprising:

1 a medium readable by a computer, the computer
2 readable medium having computer program code adapted to:

3 examine an empty indicator associated
4 with the scheduling queue;

5 refrain from searching the scheduling
6 queue if the empty indicator indicates that the scheduling
7 queue is empty;

8 search the scheduling queue if the empty
9 indicator indicates that the scheduling queue is not empty;

13 if a winning flow is found by the search
14 of the scheduling queue, detach the winning flow from the
15 scheduling queue; and
16 if no flow is found by the search of the
17 scheduling queue, place the empty indicator in a condition
18 to indicate that the scheduling queue is empty.